

CURRENT DISTRIBUTION AND SHELL MORPHOTYPES OF *RAPANA VENOSA* (VALENCIENNES, 1846) IN THE AGIGEA 4M LITTORAL

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Abstract. The Asian gastropod species *Rapana venosa*, introduced in the Black Sea waters in 1946, has been spreading quickly enough to affect the natural equilibrium in the ecosystems that it has invaded. Previous studies mentioned a broad dietary preference for bivalves, including soft bottoms infaunal species *Venus gallina*, *Gouldia minima* and *Pitar rudis* (Zolotarev, 1996), and *Cerastoderma glaucum*, *Anadara inaequivalves*. In this study we aim at analysing the length-weight, length-frequency relationships for a group of *Rapana venosa* adult specimens, collected from Agigea 4m littoral, and some aspects about morphological differences between specimens captured in three locations (Agigea, Vama Veche, typical for stony bottom and Eforie Nord, typical for the sandy substratum).

Keywords: *Rapana venosa*, length-frequency relationship, Bhattacharya method, morphotypes.

Rezumat. Distribuția actuală și morfotipurile observate la specia *Rapana venosa* la Agigea 4 m litoral. *Rapana venosa*, specie de gastropode de proveniență asiatică, introdusă pentru prima dată în Marea Neagră în 1946 s-a răspândit destul de repede încât să afecteze echilibrul natural al ecosistemelor în care a invadat. Studiile efectuate anterior menționează o preferință variată pentru hrană, sunt prădate și specii de bivalve care trăiesc îngropate în sediment ca: *Venus gallina*, *Gouldia minima* și *Pitar rudis* (Zolotarev, 1996), dar și *Cerastoderma glaucum*, *Anadara inaequivalves*. În studiul de față am analizat relațiile lungime-greutate, lungime-frecvență pentru un lot de indivizi adulți colectați din zona Agigea, de la 4 m adâncime precum și aspecte legate de diversitatea morfologică a indivizilor capturați din trei locații (Agigea, Vama Veche, tipice substratului dur și Eforie Nord, locație tipică substratului nisipos).

Cuvinte cheie: *Rapana venosa*, relația lungime-frecvență, metoda Bhattacharya, morfotipuri.

Introduction

The Asian gastropod species *Rapana venosa* is native to the Sea of Japan, Yellow Sea, Bohai Sea and the East China Sea till Taiwan.

It was recorded for the first time in European waters in 1946 in the Black Sea. Its establishment is owed to its ecological fitness, this species has a high fertility (Chung et al., 1993), a high growth rate (Ciuhcin, 1984), and a high tolerance to a severe environment, low salinity, hypoxia, water pollution (Zolotarev, 1996). In these conditions, the impact of this invasive species on autochthonous fauna was strong enough to change its equilibrium. Previous studies mentioned a broad dietary preference for bivalves, including soft bottoms infauna species *Venus gallina*, *Gouldia minima*, *Pitar rudis* (Zolotarev, 1996), and *Cerastoderma glaucum*, *Anadara inaequivalves* (pers. comm). For the first time, decline of *Mytilus galloprovincialis* populations in Bulgarian waters, Kerch Strait and Caucasian waters was caused by *Rapana* predation (Marinov, 1990; Rubinstein & Hiznjak, 1988).

In this study we aim at analysing the length-weight, length-frequency relationships for a group of *Rapana venosa* adult specimens, collected from Agigea 4 m littoral, and some aspects about morphological differences between specimens captured in

three locations (two of them typical for the stony substratum, covered by mussels and the other typical for the sandy substratum).

Material and Methods

The specimens were collected by diving from Agigea, 4 m depth, from a stony bottom covered by mussels. The chosen visual transects were 1 m, 2 m, 4 m broad and have different lengths, covering a total area of 7200 m². All individuals were measured and weighed in lab and then released in the same natural area.



Figure 1. Rapana specimens brought in lab in order to be measured and weighed.

For morphological analyses there have been selected three lots of whelks from Agigea, Eforie Nord and Vama Veche. We took into account the following phenotypic traits:

- outer shell colour (light brown-1, brown-2 and dark brown-3),
- shell aperture colour (yellow-whitish-1, orange-2, brown-3),
- shell stripes (evident/unevident),
- shell spines (pronounced-1/non pronounced-2),
- marginal teeth (pronounced-1/non pronounced-2).

Basing on these five morphological features, every individual got a code. There have been identified 15 morphotypes.

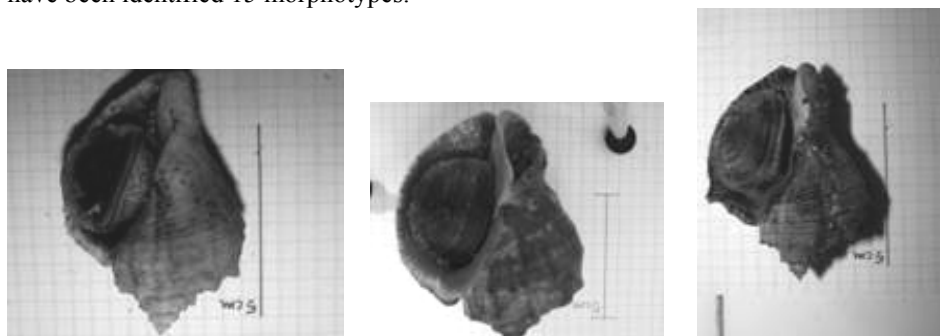


Figure 2. Individuals having different shell phenotypes.

Results and Discussion

A total of 5190 individuals were analysed, they have been measured and weighed. The maximum values for length and weight were 175 mm and 310.65 g, and the minimum values were 36.09 mm and 12.07 g.

By using Bhattacharya method for the length frequency data (FISAT II program), two year classes were determined, general data are presented in Table 1. The equation used to establish the age classes was: $L=22.71 * G^{0.281}$.

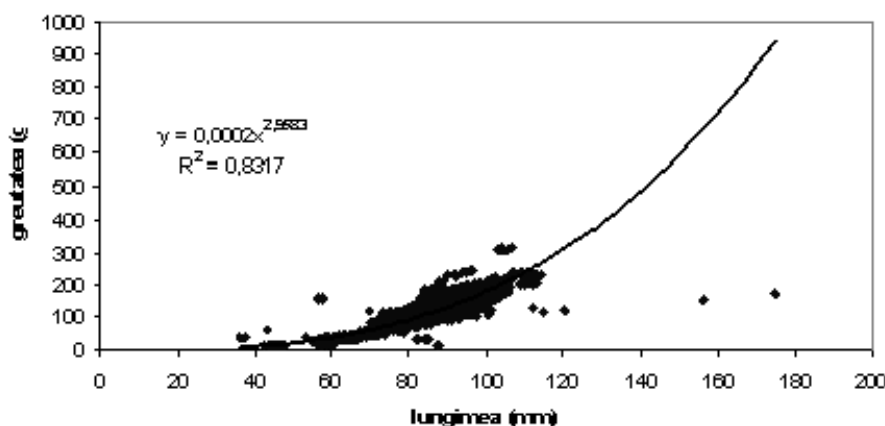


Figure 3. Length-weight relationship for *Rapana venosa*.

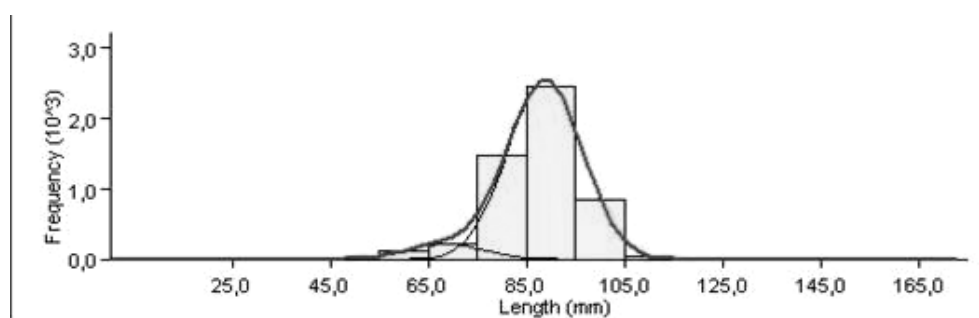


Figure 4. Age classes derived by Bhattacharya method

Group	Computed Mean	S.D.	Population	S.I.
1	68,43	7,760	409,00	n.a.
2	88,77	7,610	4889,00	2,650

Table 1. General data derived for the two groups.

The separation index value (S.I.>2) for the identified groups shows a significant difference between the two marked age classes. It is noticeable the absence of small sized individuals, this can be correlated with their depth distribution; it is possible that small individuals are merged onto higher depths.

It is remarkable also a clear difference between the identified age classes, without any transition class (the great number of individuals analysed could suggest this fact). There is still a question, if, after a certain age, the length and weight growth is less significant, but this thing can be elucidated after performing some sections along the increasing rings.

Morphological diversity. There have been analysed 95 individuals captured from 4m depth at Agigea, Eforie and Vama Veche, in order to estimate the morphological diversity. Using as parameters the five morphological features mentioned above, we

estimated the variation between *Rapana venosa* individuals, occupying these three locations, variability that could indicate a possible genetic diversity as well.

Thus, in Agigea, there have been identified 10 morphotypes for 67 analysed specimens, the most common were 12222 (light brown shell, orange aperture, stripes no evident on exterior shell, not very pronounced shell spines and not well defined teeth on the aperture) and 22121 (brown shell, orange aperture, with evident stripes on the exterior shell, not very pronounced shell spines and well defined teeth on the aperture).

In Eforie, on sandy bottom, there have been collected 4 specimens that displayed 31222 and 22221 morphotypes. Because of their isolated presence and their smaller sizes recorded in Eforie, comparatively with Agigea and Vama Veche, we couldn't establish an intrapopulation morphotypes difference.

In Vama Veche, a greater diversity of morphotypes was recorded, comparatively with Agigea. From 10 identified morphotypes, the most common was 22122 (brown shell, orange aperture, with evident stripes on the exterior shell, not very pronounced shell spines and not well defined teeth on the aperture).

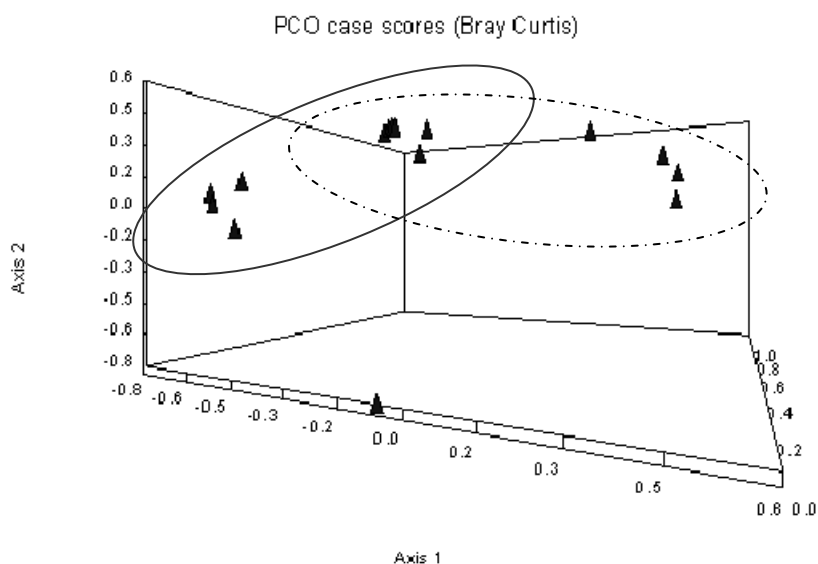


Figure 5. Morphotypes variability graphic (uninterrupted line, Vama Veche, interrupted line, Agigea)

As it can be seen in Fig. 5, there is great variability between *Rapana venosa* populations from Agigea and Vama Veche, concerning the morphological characters, although the two biotopes are very similar, *Mytilus galloprovincialis* bivalve being the dominant species.

Previous studies on the same species mentioned a high correlation between type of substratum and morphological changes recorded (Savini *et al.*, 2004). Although it is considered a very low morphological and genetic variations for *Rapana venosa* population from the Black Sea and this could stand for the “founder effect” (Mayr, 1964) hypothesis, basing on our results concerning the two populations, we can assume that, after an initial invasion, some other invasion episodes followed but, with no demographic and genetic changes. In that way, the appearance of isolated populations was possible. These premises must be correlated with the genetic information and large groups must be studied.

Conclusions

In our study, we remarked the absence of small sized individuals of *Rapana venosa* at Agigea 4m depth, this can be correlated with their depth distribution; it is possible that small individuals are merged onto higher depths. The great number of *Rapana* adults identified could be a consequence of a massive presence of *Mytilus galloprovincialis* (their main food resource). There is still a question, if, after a certain age, the length and weight growth is less significant, but this thing can be elucidated after performing some sections along the increasing rings.

There is noticeable variability between *Rapana venosa* populations from Agigea and Vama Veche, concerning their morphological features, although the two biotopes are very similar, with *Mytilus galloprovincialis* species, the dominant one.

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